

the methods of mathematical analysis. So long as our English university colleges are, to a great extent, in the hands of oligarchies, who attach more importance to such trifles as the handwriting and spelling of matriculation or medical preliminary students than to higher scientific study, such courses of training will only be accessible to those who seek them in countries more enlightened in the matter of scientific education than Great Britain. We can readily imagine that Bjerknæs' theories may find their way into many transatlantic universities among the "classics of science." They have, indeed, no small claim to be regarded as classical. It is true, as Prof. V. Bjerknæs points out, that his father's and Kirchhoff's work in several cases somewhat overlapped, but it would appear that in developing the theory of motion of spheres in liquids as a basis for explaining the properties of matter, Bjerknæs stood entirely on ground of his own making. Other theories involving the conception of a continuous medium have sprung up; we have had the vortex-atom theory before us, and we now find it necessary to postulate the existence of an ether, whose attributes resemble those of an elastic solid rather than a fluid. At the present time few will regard the hypothesis of pulsating spheres as of more than classical interest. As having been first developed in the face of a prevalent belief in the doctrine of action at a distance, and as ingenious methods of replacing this action at a distance by the action of an intervening medium, the application of the term "classical" to these investigations of C. A. Bjerknæs may not be altogether without justification.

G. H. BRYAN.

#### PHOTO-MICROGRAPHY.

*Photo-micrography.* By Dr. Edmund J. Spitta. Pp. xi + 163. (London: The Scientific Press, Ltd., 1899.)

A QUARTER of a century has now elapsed since the renaissance of the art and science of photo-micrography. Up to that time much of the best work in this direction was accomplished in America by Lieut.-Colonel Woodward, of Washington, whose successful photographs of diatoms excited the admiration of all microscopists who saw in his productions the faithful delineations of those "markings" on them, on which many hours of microscopical manipulation had been spent in bringing their delicate tracery to a correct definition. From that time to the present the fascination of transferring the minutest details of histological and biological science to the photographic plate has found many ardent votaries, with the result of improved apparatus and lenses corrected to such a degree of accuracy for this work that sharp and well-defined images can now be obtained in a manner that would have been a boon and a revelation to workers twenty-five years ago.

Amongst the latest exponents of this branch of microscopical science we must name that of the author of the book under consideration.

Dr. Spitta in this work on photo-micrography has dealt with the subject very fully and from a scientific standpoint, so that the student who takes up this branch of the photographic art is thoroughly furnished with all

the information necessary to the accomplishment of perfect work, leaving, however, only that amount of *personal experience* to be obtained and which will be demanded of every one who first embarks on this art, and without which he is liable to be landed in many difficulties.

In Chapter i. the author deals with illuminants, a by no means unimportant point for consideration; for although we have several good illuminants for low power work, it is when we come to work with the highest power objectives that either the lime-light or that of the electric arc lamp must be employed to produce the best possible results. These lights are not always readily accessible; but as the aspiring student most probably will try his 'prentice hand on low power work, the single wick lamp burning the best paraffin oil will furnish him with a light sufficiently rich in actinic rays that, provided the proper length of exposure be given, will result in a very successful negative. Dr. Spitta in Chapter ii. proceeds to give directions for obtaining photo-micrographs by low power objectives, dealing with this in such a lucid manner that the student who closely follows his clear description cannot fail in being rewarded by satisfactory results, being assisted in his work by algebraical formulæ and illustrations of simple but effective apparatus.

Chapter iii. deals with medium power photo-micrography, and contains some very necessary cautions relative to the avoidance of vibrations in the apparatus, for, as the author observes, "when photographing at 1000 diameters, 1/1000 of an inch shake in the specimen makes a shift of one inch in the photographic plate," or he might have said in the photographic *image*; therefore the absolute necessity of the most perfect stability, not only in the apparatus but even in the studio, can be readily understood and provided for—even a heavy tread on the floor of an adjoining room being sufficient to disturb the steadiness of the optical arrangement. Dr. Spitta describes different methods whereby this difficulty may be overcome. Allowance must also be made for the expansion of the metal of the microscope from the heat of the illuminant, for even in low power work, say of 250 diameters, the heat from the oil lamp must not be considered a negligible quantity, and must be considered so far that no photographic exposure should be attempted till the metal has had time to become fully expanded.

Chapter iv. is overloaded with woodcuts of different makes of microscopes valuable as affording the student a choice of various instruments, but by no means necessary to his work, as any one of these is sufficient for attaining good medium power work. This chapter also deals with the subject of lenses and eyepieces and the accessory fittings of the microscope generally; but there is one point that must have the greatest attention, and that is the fine adjustment, and Dr. Spitta does well in laying great stress upon its importance; nothing is more embarrassing to the operator, when perhaps everything else in the apparatus is working well, to find that the fine adjustment by which he hopes to obtain that sharp definition without which his work is valueless, is altogether useless from faulty construction, and Dr. Spitta describes the various forms of this all-important addition to the photo-micrographic installation.

The remaining three chapters of this work treat of such subjects as substage fittings, coloured screens, and the various subsidiary apparatus useful in high power or "critical" photo-micrography. These particulars do not bear the condensation that is necessitated by the space allotted to this report, but are full of information for the guidance of the photo-micrographic student and will materially assist him in his work. A valuable feature is included in the appendices, and is headed "25 common faults in photo-micrography; their causes and means of cure"; by a reference to p. 152 every error that may present itself in the beginner's work is described, the reason for it given, and the remedy indicated. Added at the end of the book are five plates of representative work in photo-micrography, the work of the author, while a copious index brings the work to a conclusion.

#### GEORGE KINGSLEY'S LIFE AND WRITINGS.

*Notes on Sport and Travel.* By George Henry Kingsley. With a memoir by his daughter, Mary H. Kingsley. Pp. viii + 544. (London: Macmillan and Co., Ltd., 1900.)

THIS is a book, we venture to think, that most readers will lay down with deep regret—regret that a very talented writer, an acute observer, and an ardent sportsman (in the best sense of the word) should have bequeathed so little of his experiences to the world. For George Kingsley, a member of a clever family (or, as his biographer will have it, a member of a clever generation of an ancient family), was evidently a man far above the ordinary intellectual level, and enjoyed unrivalled opportunities of adding to our store of knowledge by travel in distant lands at a time when they were still, to a great extent, populated by their native denizens and unspoiled by the march of civilisation. Unfortunately, however, he seems to have been devoid of those regular and methodical habits of work by which alone the results of a life of exploration and travel can be properly recorded, and we have consequently to be content with mere scraps and fragments of a vast store of information.

From such scraps and fragments as the editor, who is to a great extent also the author, of the present volume has been able to save from oblivion, we glean how keen an observer and how true a lover of nature was Dr. Kingsley. Whether among the coral-girt isles of the South Pacific, when they were yet in great part free from the "beach-comber," or on the prairies of the "wild west," at a time when the bison were still to be numbered by hundreds, if not by thousands, his descriptions of scenery and animals are life-like pictures.

The greater part of the account of the author's travels is given in the memoir by his daughter, which occupies more than a third of the whole volume, and is, in great measure, in the form of letters or of extracts from the same. And here we take the opportunity of expressing our sense of the excellent manner in which Miss Kingsley—herself a traveller and writer of world-wide repute—has discharged what must evidently have been a task of no ordinary difficulty.

Kingsley (in company with the late Lord Pembroke)

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visited the South Seas in the late "sixties"—a time when yachting in those latitudes had not come into vogue; and such descriptions as he has left of the natives and natural products only make us regret that they were not fuller. Fish seem especially to have attracted his attention; but when he states that he disbelieves the story of a *Chaetodon*<sup>1</sup> shooting water at a fly, the editor should have added that the only fish which performs this feat is a species of *Toxotes*, whose southern range only extends to North Australia, so that it could not have come under the ken of the author.

The travels in Canada and the United States were undertaken in company with Lord Dunraven, between 1870 and 1875; parts of them being described by the latter in "The Great Divide."

Of the various collected papers of Dr. Kingsley, perhaps the most interesting to the naturalist is the one entitled "Among the Sharks and Whales." Here the author graphically describes, as an eye-witness, certain encounters between the larger Cetaceans and smaller members of the same order, together, perhaps, with other denizens of the deep. We are told, for instance, how some of these creatures, of thirty feet or so in length, were seen to leap clean out of the water, and then to fall with a sounding "smack" that could be heard half a mile off. But whether the creatures in question were attacking a whale, or leaping for mere fun, the author was unable to determine. Neither could he say definitely whether or no they were "killers." And he seems, indeed, to be somewhat confused between "killers" and "threshers"; although, as to the sharks commonly called by the latter name, he denies that they ever attack whales, adding that he has never even known a shark of any kind throw itself out of the water. R. L.

#### OUR BOOK SHELF.

*Irrigation and Drainage, Principles and Practice of their Cultural Phases.* By F. H. King, Professor of Agricultural Physics in the University of Wisconsin, author of "The Soil." The Rural Science Series. Pp. xxi + 502. (New York: The Macmillan Company. London: Macmillan and Co., Ltd., 1899.)

THE object of this book, as stated in its preface, is "to present, in a broad yet specific way, the fundamental principles which underlie the methods of culture by irrigation and drainage," and we may say that we consider the author successfully does this.

The introductory chapter treats of the importance of water in cultivation, and in it a number of interesting experiments on the amount of water absorbed by cereals and other plants, and the weight of dry matter produced are described, from which it appears that with cereals the amount of water used varies from about 300 to 500 lbs. per pound of dry matter produced. The general result of these experiments is considered to show "that well-drained lands in Wisconsin, and in other countries having similar climatic conditions, are not supplied naturally with as much water during the growing season as most crops are capable of utilising, and hence that all methods of tillage which are wasteful of soil moisture detract by so much from the yield per acre."

<sup>1</sup> The editor avows a difficulty in deciphering some of the MS. which came into her hands, and therefore suggests the possibility of a certain amount of mis-spelling. Some naturalist friend would, however, doubtless have corrected the following errors, viz.:—P. 61, *Chaetadons* for *Chaetodons*; p. 222, *Haroldus* for *Harelda*; p. 414, *Megaptera australis* for *Balaena australis*; p. 421, *Ovules* and *Mutras* for *Olivos* and *Mitras*; and p. 424, *Orcus* for *Orca*.